Incomplete Urethral Duplication Associated with a Dermoid Cyst in a Dog with Urinary Obstruction

SPONTANEOUSLY ARISING DISEASE

Short Title: Urethral Duplication in a Dog

Incomplete Urethral Duplication Associated with a Dermoid Cyst in a Dog with Urinary Obstruction

F. Thierry, S. Drew, J. Del-Pozo, N. Fernandez-Salesa, S. Woods, G. Stanzani and T. Liuti

University of Edinburgh, Royal (Dick) School of Veterinary Studies, Hospital for Small Animals, Easter Bush Veterinary Centre, Roslin, Midlothian, UK.

Correspondence to: F. Thierry (e-mail: fthierry@exseed.ed.ac.uk).

Summary

A 20-month-old male miniature dachshund was evaluated for a 10-week history of intermittent stranguria, pollakiuria, haematuria and obstructive urolithiasis. Retrograde urethrocystography revealed a subcutaneous saccular structure in the perineal area connected to the intrapelvic urethra associated with urolithiasis. After excision of the perineal saccular structure, microscopical examination confirmed the presence of transitional epithelium lining the diverticulum with isolated submucosal smooth muscle bundles. This structure was attached to another saccular structure lined by stratified squamous keratinizing epithelium with hair follicles, sebaceous glands and apocrine glands. An incomplete urethral duplication with dermoid cyst was diagnosed. The dog recovered uneventfully from surgery and was still urinary continent and free from clinical signs 5 months after surgery. To the authors' knowledge this is the first report of an incomplete urethral duplication with a dermoid cyst and concurrent obstructive urolithiasis in a dog.

Keywords: dog; urethral duplication; dermoid cyst; urolithiasis

Urethral duplication is a rare congenital disorder characterized by the presence of an accessory urethra originating from the bladder neck or arising from the primary urethra (Levin *et al.*, 2007; Bello, 2014). Several anatomical variations exist depending on the location and opening of the duplicated urethra. Urethral duplication can be described as complete if the diverticulum has an external opening (Bello, 2014) or incomplete if the diverticulum is blind ended (Anderson *et al.*, 1980; Lawrence *et al.*, 1983). Only four cases of urinary duplication have been described in the veterinary literature (Tobias and Barbee, 1995; Duffey *et al.*, 1998; Stedile *et al.*, 2008; Palm *et al.*, 2015). To the authors' knowledge,

neither urolithiasis nor dermoid cyst has ever been reported in association with urethral duplication.

A 20-month-old male miniature dachshund was referred to the Hospital for Small Animals, Royal (Dick) School of Veterinary Studies, with a 10-week history of intermittent stranguria, pollakiuria, haematuria and obstructive urolithiasis. The dog had been treated prior to the current presentation by the referring veterinary surgeon with retrograde hydropulsion and two cystotomies, resulting in removal of struvite urethroliths. Further treatment of concurrent urinary tract infection by *Staphylococcus* spp., *Proteus mirabilis* and coliform bacteria with antimicrobial therapy (potentiated amoxicillin) based on antibiogram failed to resolve the clinical signs 3 weeks after the initial presentation. On presentation to the referral hospital 10 weeks after the initial clinical signs, physical examination revealed marked pain on abdominal palpation, a distended and turgid bladder and a fluid-filled swelling in the perineal region. The rest of the physical examination was largely unremarkable. Haematological analysis demonstrated neutrophilia (22.1×10^9/l, reference interval [RI]: $3.6–12 \times 10^9$/l) suspected to be secondary to chronic urinary tract infection. Serum biochemistry revealed increased creatinine (257 μmol/l, RI: 40–132 μmol/l) and urea (32.6 mmol/l, RI: 1.7–7.4 mmol/l) due to obstructive urolithiasis. Alkaline phosphatase (393 U/l, RI: 20–60 U/l) and bile acids (9.2 μmol/l, RI: 0–7 μmol/l) were also elevated. These findings could have been secondary to chronic stress and functional cholestasis induced by sepsis. The urinary obstruction was relieved by urinary catheterization and further urinalysis documented marked haematuria, moderate proteinuria and low urine specific gravity (1.017). A cystocentesis was performed and urine culture isolated *Staphylococcus pseudointermedius*, which was sensitive to potentiated amoxicillin.

Plain abdominal radiographs revealed several cystoliths, urethroliths and a tubular mineralized structure within the perineal soft tissues. Retrograde urethrocystofluorography

and retrograde hydropulsion were performed, highlighting a subcutaneous saccular structure in the perineal area connected to the intrapelvic urethra and containing a small number of uroliths (Fig. 1). Careful examination of the perineal area did not reveal any opening or wound. A caudoventral midline coeliotomy was performed and multiple uroliths were retrieved via cystotomy. The perineal saccular structure was then dissected, ligated as cranial as possible and excised via a perineal approach (Fig. 2). The dog was still urinary continent and free from clinical signs 5 months after surgery.

Grossly, the excised saccular structure measured 25 × 20 × 12 mm, was mottled tan brown to pale pink and oval shaped with an irregular and slightly nodular surface. It was attached to a 20 × 4 mm pale pink, tubular structure. Following fixation in 10% neutral buffered formalin, samples were processed routinely and embedded in paraffin wax. Sections (5 μm) were stained with haematoxylin and eosin. Microscopically, the tubular structure (Fig. 3A) was lined by transitional epithelium with mild, multifocal, transepithelial trafficking of lymphocytes and neutrophils. Diffusely, the superficial submucosa of this structure contained moderate numbers of lymphocytes and plasma cells with fewer neutrophils and macrophages, which occasionally aggregated around blood vessels (perivascular cuffing). Multifocally, there were isolated bundles of smooth muscle. At the entrance to the saccular structure the transitional epithelium abruptly became stratified squamous keratinizing epithelium, lining a cystic space containing cellular debris and fragments of keratin and hair shafts (Fig. 3B). The subjacent fibrovascular connective tissue contained a predominance of dense collagen fibres, numerous well differentiated hair follicles, sebaceous glands and apocrine sweat glands (dermal differentiation). Multifocally throughout this area there was mild pigmentary incontinence characterized by macrophages containing granular, dark brown, intracytoplasmic material (melanin) and multifocal aggregates of small numbers of lymphocytes, plasma cells and macrophages (mild chronic

inflammation). Blood vessels were moderately hyperaemic/congested and occasional sweat glands were ectatic. These changes were consistent with an incompletely duplicated urethra and a dermoid cyst. Histological examination of a sample of the urinary bladder revealed severe haemorrhagic and ulcerative cystitis, likely secondary to the chronic urinary infection, and recurrent urolithiasis with intralesional foreign material, likely representing suture material from previous cystotomies.

Urethral duplication alone has been described in dogs (Tobias and Barbee, 1995; Duffey *et al.*, 1998; Stedile *et al.*, 2008; Palm *et al.*, 2015) and people (Anderson *et al.*, 1980; Lawrence *et al.*, 1983; Levin *et al.*, 2007; Canali *et al.*, 2012; Bello, 2014), and is well classified in human medicine (Bello, 2014). This disorder is more prevalent in males (Anderson *et al.*, 1980; Rabinovitch, 1993). Dogs and people do not have the same anatomical presentation of incomplete urethral duplication. In man, the duplicated urethra has an external opening, but is blind ended and does not connect to the urethra (Bello, 2014), while duplicated urethra in dogs typically arises from the prostatic urethra and ends as a saccular diverticulum without any external opening (Duffey *et al.*, 1998; Palm *et al.*, 2015). Two confirmed cases of incomplete urethral duplication with no external opening (Duffey *et al.*, 1998; Palm *et al.*, 2015) and two confirmed cases of complete duplication (Tobias and Barbee, 1995; Stedile *et al.*, 2008) have been reported in dogs.

In the present case, the duplicated urethra arose sagitally from the dorsal intrapelvic urethra just caudal to the prostate and terminated in a blind-ended saccular, subcutaneous perineal swelling. The presence of scattered smooth muscle bundles within the submucosa of the tubular structure is consistent with the expected histological appearance of urethra. In contrast, a diverticulum without myocytes is considered to result from mucosal herniation. This has been described in acquired urinary bladder diverticulum following cystotomy in a dog (Scheepens and L'Eplattenier, 2005).

Urinary incontinence and urinary tract infection are common clinical signs in human cases of duplicated urethra (Levin *et al.*, 2007; Bello, 2014). Although the dog in this report had no prior history of urinary tract disease, chronic urine stasis within the urethral diverticulum creates a favourable microenvironment for bacterial growth (Tobias and Barbee, 1995; Duffey *et al.*, 1998). Subsequent urinary tract infection with urease-producing organisms may then have predisposed to recurrent urolithiasis in this animal (Elliott, 2010). This case represents the first report of urinary duplication with concurrent urolithiasis in a dog.

The embryological explanation of urethral duplication is unclear in man and likely varies with different types of duplication. Furthermore, people and dogs appear to develop different types of incomplete urethral diverticulum. In dogs it arises from the intrapelvic urethra with a blind ending, while in man the diverticulum often arises in the distal penis. In the authors' view the cases reported in dogs resemble perineal urethral duplication, so called 'Y-duplication' in man (Levin *et al.*, 2007; Bello, 2014). At least two cases have been reported as incomplete Y-duplication in children with a similar presentation to this canine case (Anderson *et al.*, 1980; Lawrence *et al.*, 1983), and we suspect a similar embryological malformation as part of its pathogenesis. Abnormal fusion of the lateral urorectal folds resulting in an abnormal urogenital sinus, which is the precursor of the bladder and urethra, has been suggested (Bello, 2014). Other hypotheses have been proposed, such as an incomplete closure of the mesoderm, an ischaemic injury during embryogenesis, or an abnormal closure of the Müllerian duct (Levin *et al.*, 2007).

The presence of stratified squamous keratinizing epithelium and adnexal structures within the saccular portion of the urethral diverticulum is unusual in urethral duplication. A previous case report in a dog described a duplicated urethra associated with a cyst lined by stratified squamous keratinizing epithelium (Duffey *et al.*, 1998), without adnexal structures,

retrospectively consistent with an epidermoid cyst. Conversely, dermoid cysts are lined by stratified squamous epithelium with presence of adnexal structures, as seen in this case. They can be acquired following surgery or traumatic injury, or may be developmental. There was no wound or surgery in the perineal region reported previously in this dog, hence a congenital origin is considered most likely. Developmentally, a dermoid cyst results from an abnormal closure of the midline raphe, which triggers the inclusion of ectoderm in deeper tissues during embryogenesis. To the authors' knowledge a dermoid cyst has never been reported in association with urethral duplication in either the human or veterinary literature. In human medicine one case of intrascrotal dermoid cyst has been reported, extending to the posterior urethra (Canali *et al.*, 2012). Indeed, fistula arising from a dermoid cyst and connecting with adjacent organs such as the bladder or intestines has been described in man (Naqvi *et al.*, 2015). Squamous epithelium in the most distal aspect of the urethral diverticulum is also common in man when there is a perineal opening (Bello, 2014). In the present case, we hypothesize that the abnormal development at the origin of the duplicated urethra was concomitantly associated with ectodermal entrapment, which led to the inclusion of dermoid tissue in the urethral diverticulum.

In conclusion, this is the first report of incomplete urethral duplication associated with a dermoid cyst and urolithiasis in a dog. Urethral duplication should be considered in the differential diagnosis of recurrent urinary lithiasis.

References

Anderson RL, Altman DH, Lankau CA *et al.* (1980) Urethroperineal cyst in a newborn: posterior urethral duplication. *American Journal of Roentgenology*, **135**, 622-624.

Bello JO (2014) Congenital posterior urethroperineal fistula: a review and report of the 25th case in literature. *Urology*, **84**, 1492-1495.

Canali R, Angelini L, Castagnetti M *et al.* (2012) Scrotal dermoid extending to the posterior urethra through a corpus cavernosum in a child. *Journal of Pediatric Surgery*, **47**, 1618-1621.

Duffey MH, Barnhart MD, Barthez PY *et al.* (1998) Incomplete urethral duplication with cyst formation in a dog. *Journal of the American Veterinary Medical Association*, **213**, 1287-1289.

Elliott DA (2010) Nutritional management of the lower urinary tract conditions. In: *Textbook of Veterinary Internal Medicine*, Vol. 1, 7th Edit., SJ Ettinger, EC Feldman, Eds., Saunders Elsevier, St. Louis, pp. 696-700.

Lawrence D, Howard ER, Harris RF (1983) A case of congenital urethral duplication cyst and its embryological significance. *British Journal of Surgery*, **70**, 565-566.

Levin TL, Han B, Little BP (2007) Congenital anomalies of the male urethra. *Pediatric Radiology*, **37**, 851–862.

Naqvi KZ, Abdullah A, Jabeen M *et al.* (2015) Ovarian dermoid causing pilimiction. *Journal of the College of Physicians and Surgeons of Pakistan*, **25**, 71-72.

Palm CA, Glaiberman CB, Culp WTN (2015) Treatment of a urethral duplication in a dog using cyanoacrylate and coil embolization. *Journal of Veterinary Internal Medicine*, **29**, 727-731.

Rabinovitch HH (1993) Urethral duplication. In: *Reconstructive Surgery*, G Webster, R Kerby, B Goldwasser *et al.*, Eds., Blackwell Science, Oxford, pp. 795-803.

Scheepens ETF, L'Eplattenier H (2005) Acquired urinary bladder diverticulum in a dog. *Journal of Small Animal Practice*, **46**, 578-581.

Stedile R, Contesini EA, Oliveira ST *et al.* (2008) Urethral duplication in a dog: case report. *Arquivo Brasileiro de Medicina Veterinaria e Zootecnia*, **60**, 341-345.

Tobias KS, Barbee D (1995) Abnormal micturition and recurrent cystitis associated with multiple congenital anomalies of the urinary tract in a dog. *Journal of the American Veterinary Medical Association*, **207**, 191-193.

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Figure Legends

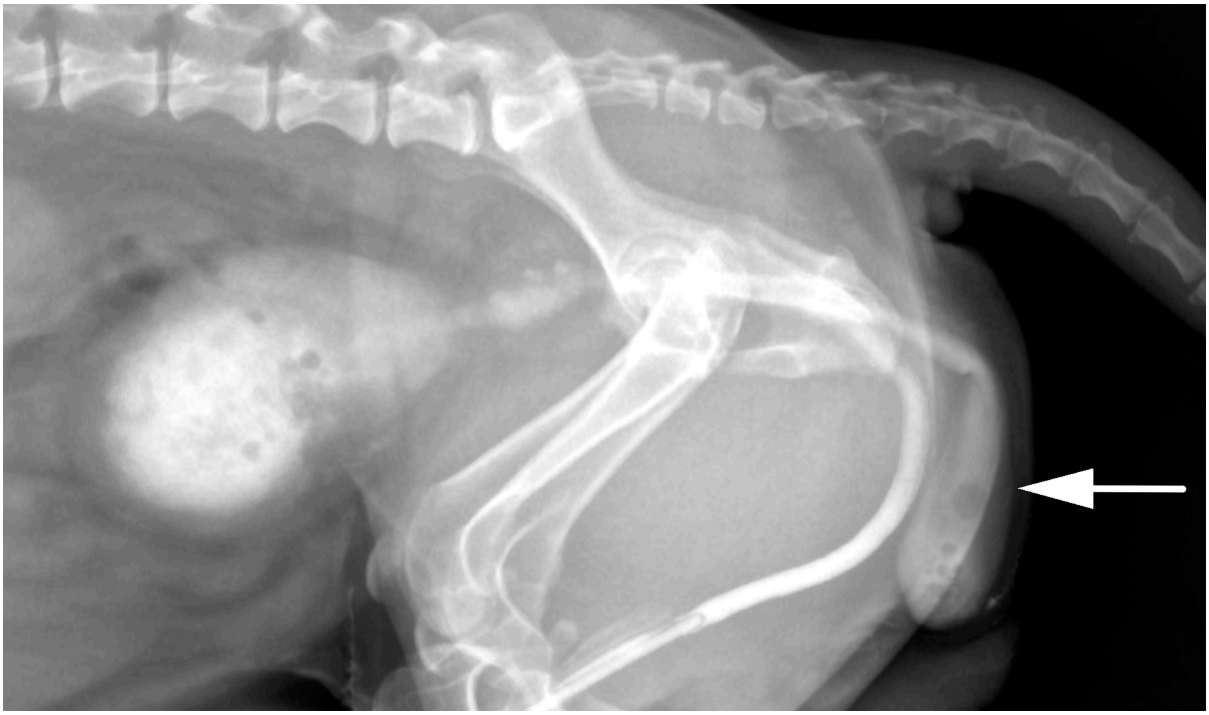


Fig. 1. Retrograde urethrocystofluorography: note the contrast filling of a saccular structure (arrow) which connects to the intrapelvic urethra; it contains small urethroliths.

Fig. 2. Urinary catheter inserted in the urinary bladder and urethral saccular structure (arrow).

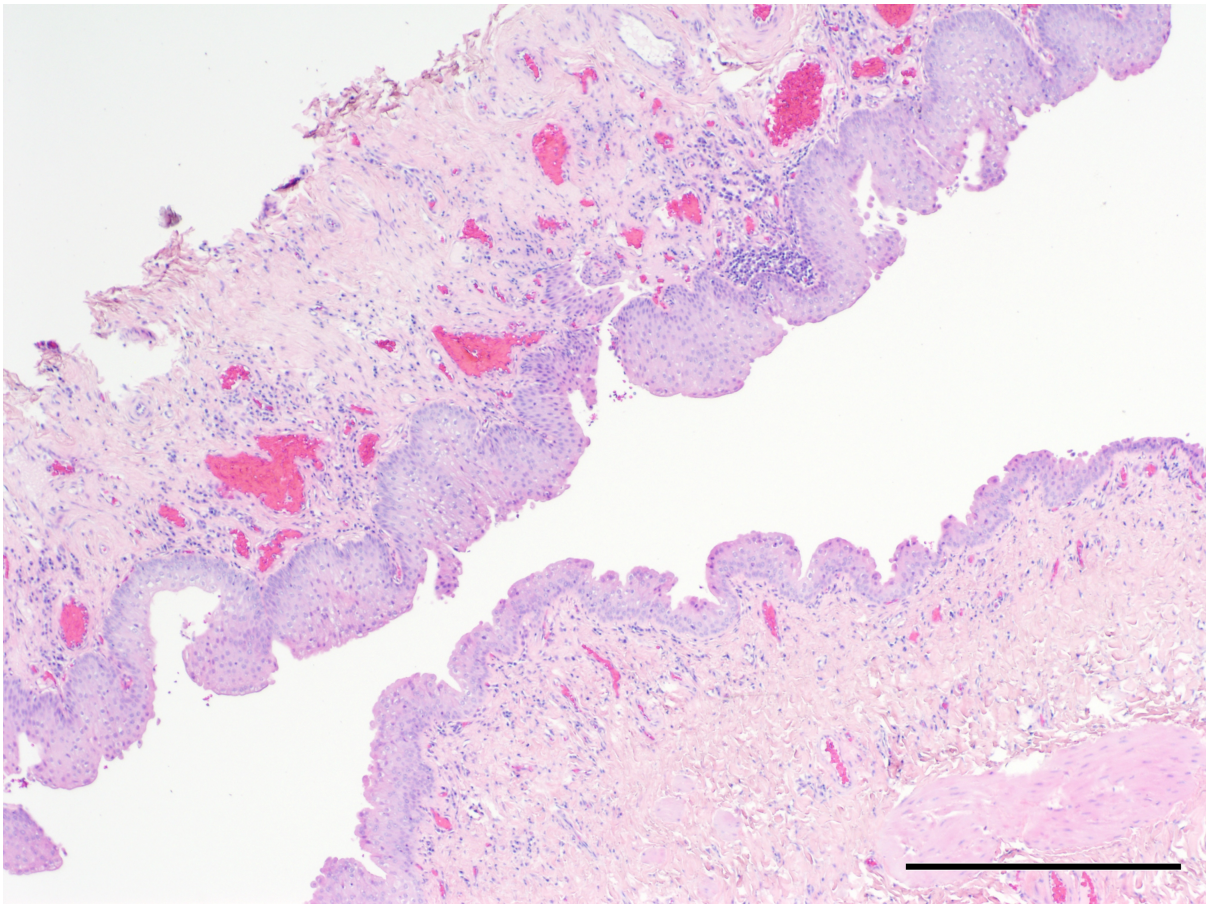
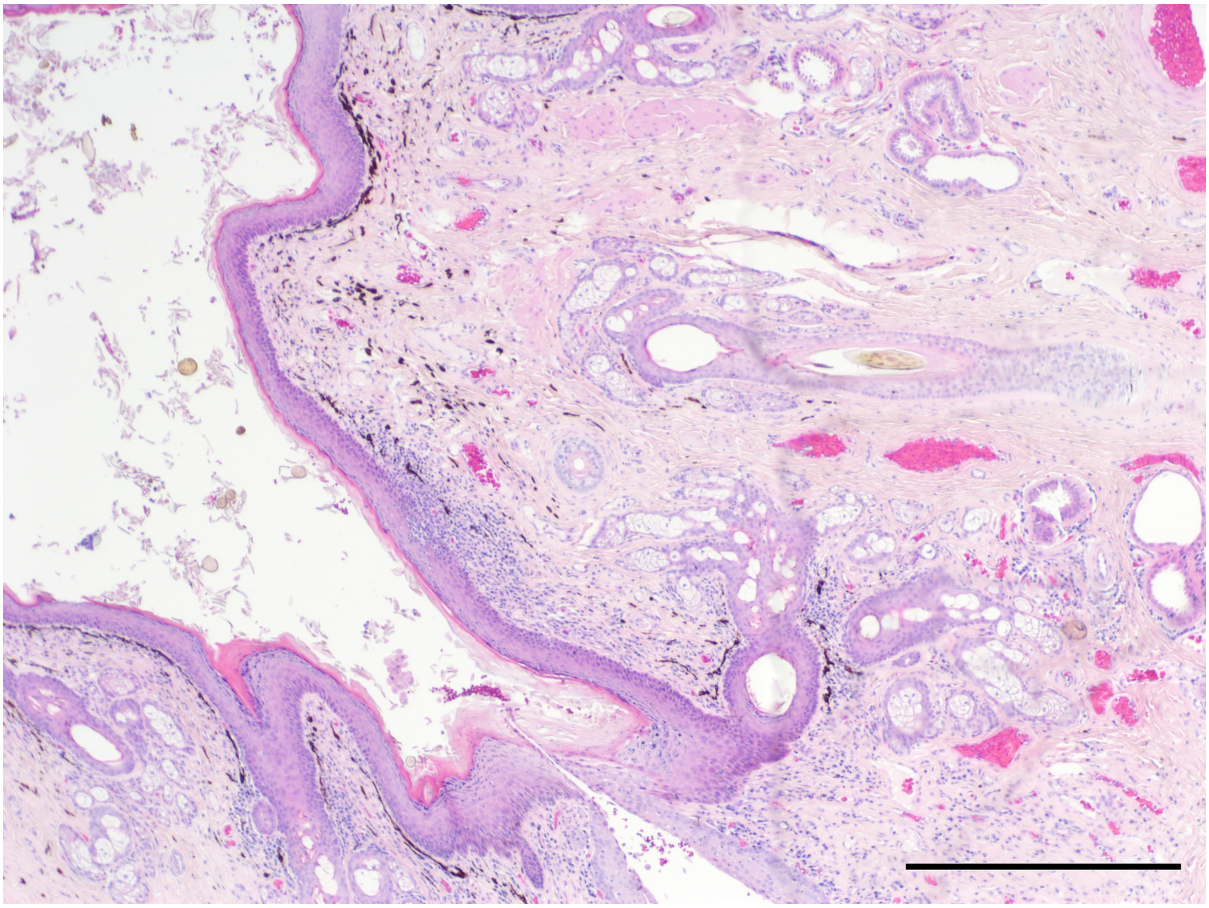


Fig. 3. (A) Duplicated urethra: a tubular structure is lined by transitional epithelium with isolated bundles of smooth muscle within the submucosa (lower right of the image). HE. Bar, 500 µm.



(B) Dermoid cyst: transitional epithelium abruptly changes to stratified squamous keratinizing epithelium lining a cystic cavity containing cell debris, fragments of keratin and hair shafts. The connective tissue wall contains numerous adnexal structures. HE. Bar, 500 µm.